virtues the Kola nut is considered to have a great future before it in European commerce, and is consequently strongly recommended to the notice of planters in our colonies for extensive cultivation. With regard to the preservation of the germinating properties of the seeds, Mr. Christy says he has received them in good condition, both in baskets and barrels lined with the leathery leaves of a tree known as the "bal tree." Some received in dry loam arrived as fresh as when they were gathered, and of some that arrived eighteen months since, the bulk is stated to be perfectly fresh and retaining still their beautiful red colour.

From a list of fifteen species of *Myristica*, the fruits or seeds of which are described, the value of the nutmeg genus is shown, especially as oil seeds. Seeds new to commerce are frequently arriving in the Liverpool and London markets, intended for the expression of oil and for the preparation of oil cake. Such seeds are of a very varied character and belong to widely different natural orders, and not long since those of *Myristica surinamensis* came into Liverpool under the name of African nuts. Upon analysis they were found to contain a large quantity of solid oil or fat with an agreeable taste, and but little, if any, odour, and when fairly pure it is said to resemble cocoa butter.

Amongst other important economic plants or drugs mentioned are the Coca (*Erythroxylon coca*), the medical effects of which have attracted so much attention of late; the Jamaica Chewstick (*Gouania domingensis*), which, it is stated, "has recently been introduced into this country by one of our leading London dentists for use in tooth powder and mouth wash," and also in the form of a fluid extract as a gargle for relaxed throat.

Of Papaine, the active principle of the Papaw (*Carica papaya*), some interesting records are given regarding its effects in treatment of diphtheria, croup, indigestion, dyspepsia, &c.

## LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### Ocular After-Images and Lightning

In reply to Mr. Shelford Bidwell's query whether the quiver of the lightning flash is a purely subjective phenomenon or not, I send the following extract from my note-book, made October, 1873:—"A flash of lightning consists of several separate flashes all occurring within a fraction of a second of each other. There was a very severe thunder storm at night, the thunder almost continuous. Drawing the curtain across the window so as to expose only a narrow slit of skylight, I observed this slit in the looking-glass which I kept moving rapidly backwards and forwards on its axis. Whenever a flash occurred, several images of the slit appeared, showing that there were several successive illuminations of the slit."

This was not the result I had expected, the experiment having been suggested to my mind in consequence of some experiments I had been making on the phenomenon of recurrent vision The results of these experiments were published in the *Phil. Mag.*, December (supplement), 1872. One object of my experiments was to determine in what way the colour of the recurrent image depends upon the colour of the light producing it. By using a sliding shutter and a small window covered with different coloured glasses, I found that the colour of the recurrent image tends to be of a tint complementary to that of the light causing it, being, however, in all cases bluer than the complementary tint. I add the following extract from my paper:—"A recurrent image of an object may be produced without any apparatus whatever. To do this, place the right hand over the eyes so that the palm of the hand covers the right eye, and the fingers the left eye. If the middle finger be then raised for a moment, so as to admit light for as short a time as possible into the eye, a recurrent image of any light-coloured object held against a dark background may be seen. The effect is much better seen by twilight or gaslight than in full daylight. This method of producing a recurrent image is, however, much inferior to that in which a sliding shutter is used, owing probably to the illumination of the retina not being sufficiently instantaneous.

Cheltenham College, June 6 A. S. Davis

### A Quinquefoliate Strawberry

In your issue for April 30 (vol. xxxi. p. 601) is an account of a quinquefoliate strawberry. In the garden of the New York Agricultural Experiment Station at Geneva we have some second year seedling strawberries, some of which are bearing three, four, and five leaflets on the same plant, the leaves all large and perfect. We have other plants in which the two extra leaves are borne half way down the petiole, and which attain fair size, and yet others where these stipulary-like appendages are reduced to hair-like bracts. The variety of strawberry introduced under the name "Mrs. Garfield" frequently has these bract-like appendages. While speaking of the strawberry, I would remark that seedling strawberries very frequently are unifoliate during their early growth, and it appears as if Duchesne's *Fragaria monophylla* may be regarded as an instance of arrested development in one of these one-leaved younglings.

E. Lewis Sturtevant

New York Agricultural Experiment Station,
Geneva, N.Y., May 28

## OBSERVATIONS OF THE TEMPERATURE OF THE SEA AND AIR, MADE DURING A VOYAGE FROM ENGLAND TO THE RIVER PLATE IN THE S.S. "LEIBNITZ"

Being obliged to proceed to South America at the beginning of this year, I took with me a thermometer and a hydrometer in order, if circumstances were favourable, to provide myself with occupation during the somewhat long and monotonous voyage. Thanks to the kindness and courtesy of Capt. Brown, of the s.s. *Leibnitz*, who took a lively interest, and assisted me greatly in carrying out my observations, the voyage was neither long nor tedious.

The *Leibnitz* sailed from Southampton on January 16, 1885, and made the passage direct, without touching at intermediate ports, to Monte Video, where she arrived on February 8, after a very favourable voyage. The route lay through the most interesting meteorological districts of the Atlantic, and my principal object at starting was to make as many observations of the temperature and the density of the surface-water along the route as possible. With these I combined observations of the temperature of the air, and frequently also of the wet-bulb thermometer. Observations were begun on January 21 in lat. 34° N., and continued up to the morning of arrival in the River Plate.

I have put together the simultaneous observations of the temperature of the air and the water with those of the wet-bulb thermometer, as they possess some interest of their own; the observations of density are kept for a future opportunity, as the reductions in connection with them are not quite finished.

The *thermometer* used for all the observations was divided into simple degrees of the Centigrade scale, and was of the ordinary form of German manufacture, with a paper scale. The degrees were 1·6 mm. apart, so that there was no difficulty in estimating tenths of a degree. Its zero was verified on board by immersing it in pounded ice, and found correct. The ice was well pounded in a clean towel, and a soda-water tumbler filled with it; the thermometer was then thrust into it and allowed to remain till sufficient ice had melted to fill up the interstices, producing a perfect magma of ice and water down to the bottom. The mercury remained constant on the zero line. The temperature of the air was 25° C.[1]

*Temperature of the Water.*—The water was collected in a small bucket, well clear of the side of the ship, and on the opposite side from that through which the condensing water of the engine is discharged. Its temperature was determined as soon as the sample was brought on board.

As the ship left the Channel in the middle of winter, and proceeded nearly due south, the temperature of the water rose rapidly at first. Observations were begun on January 21, in lat. 34° N., and between this latitude and lat. 10° N. the rate of rise was very steady, averaging 0·36° C. per degree of latitude. From lat. 5° N. to 15° S. the temperature is very uniform and high, averaging 26·86° C. After passing lat. 15° S. the temperature falls, and begins to show greater variations, as the shallow water on the Abrothes Bank is approached. The average temperature of the water over this bank was 25·56° C. After passing Cape Frio, and between the parallels of 25° and 30° of south latitude, the variations of temperature are considerable and often abrupt; the maximum observed in this part was 26°·7 C., and the minimum 24°·3 C. As the higher temperature generally accompanies a greater salinity, it is probable that these variations are due, not to any terrestrial source, such as large rivers, but to an oceanic cause, the less salt and colder water of the deeper ocean strata being thrown up against the coast, and mixing imperfectly with the hot and dense surface-water. In lat 30° S. the influence of the River Plate makes itself distinctly felt by a general rapid fall of temperature. As the ship got into soundings, with the change in colour and other properties of the water, the temperature fell rapidly to between 23° and 24° C., and to 22° C. in six fathoms off Flores Island close to Monte Video. The minimum temperature observed in this part was 20° C. at 2 a.m. between Lobos Island and Maldonado Point.

Excluding the latter part of the voyage between the River Plate and lat. 15° S., where the conditions are a good deal affected by purely local causes, the surface-water shows well-marked diurnal maxima and minima of temperature. From lat. 9° N. to lat. 2° N. the ship passed through the equatorial belt of calms and rains, which separates the regions of the north-east and the south-east trade-winds from each other. It is characterised by a calm sea, a cloudy sky, and heavy rains. Here the temperature was subject to very little diurnal variation (0°·3 C.) On approaching St. Paul's Rocks, a few miles north of the equator, the clouds cleared away completely, and there was a calm sea, a clear sky, and a very powerful sun. The result was a comparatively great rise of temperature in the afternoon; and yet the greatest difference between any neighbouring maximum and minimum in this region was only 1°·1 C.

The maximum temperature of the sea-surface observed during the voyage was 27°·4 C. (81°·3 F.) at 2 p.m. on January 31, in lat. 7° 35′ S., the Brazilian coast being about 100 miles distant. The temperature of the water will be further considered in connection with its density; at present its connection with the temperature of the air will be more particularly considered.

*Temperature of the Air.*—Along with the temperature of the water, that of the air during daylight was determined. It is probably very rare, in any part of the ocean, to find the mean temperature of the air agreeing accurately with that of the surface water, and in many places the differences are considerable. In order to be able to compare the temperature of the air with that of the water, it is necessary that both should be determined with equal accuracy. The temperature of the water is easily and accurately determined by agitating the thermometer in a bucket of it freshly collected. With the air it is somewhat different. Having only one thermometer with me, I was obliged to use it for all purposes, and I could not hang it up in a thermometer-box, even if I had had one, and had deemed it advisable to do so. On board ship, however, I am convinced that it is quite impossible to fix a thermometer-box in such a position as always to secure such an air-pressure as to justify the assumption that the indications of the thermometer may be taken as the true temperature of the air. Even on shore and under the most advantageous circumstances, the temperature of the thermometer in the atmosphere of the best constructed box is too much dependent on the temperature and capacity for heat of the material of the box for it to be assumed always to be identical with that of the air outside, at the moment of reading. I was obliged, therefore, to adopt the method of whirling the thermometer, at the end of a short string, in the air, in whatever part of the ship happened at the moment to afford the most favourable conditions, and reading it when it had assumed a constant temperature. The temperature of the air is thus determined in mostly the same way as that of the water, namely, by agitating a thermometer in it, and the comparison of the two is therefore likely to lead to trustworthy conclusions.

*Temperature of Wet-bulb Thermometer.*—The series of observations with this instrument is not so complete as that with the dry thermometer, but they possess some interest. The method of observation was the following:—The temperature of the air having been determined by whirling the thermometer in it, a bucket of sea-water was fetched and its temperature taken; the thermometer was then exposed, with its bulb still wet with sea-water, to the breeze in a proper part of the ship, and its temperature observed when it became constant. The exposure of the instrument requires some care. The bulb must be quite free from grease, which can be readily secured by washing it with soap and water. It is then dipped into the water and allowed to drip for a second. It is then held somewhat inclined to the direction of the wind and to the horizon, and rotated gently on its axis so that the bulb be kept covered with a continuous film of water which is locally thickened by gravity, which tends to form a drop on the lower side of the bulb. The reading of the thermometer is observed while it is being rotated. Had I intended from the beginning to make a series of wet and dry bulb observations, I should probably have used fresh water from the first. I began to expose the thermometer, merely in order to have an indication whether the atmosphere were saturated or not, and I expected, in the damp equatorial regions, to find the atmosphere so heavily saturated as to be incapable of producing any sensible lowering of the thermometer with damped bulb. For this purpose it seemed to be quite sufficient to expose the thermometer wet with sea-water. Having begun with sea-water the observations were continued with it. A few comparative observations were made in order to determine the effect of replacing the sea-water by fresh water. On February 2, after a shower, the temperature of the air was 25°·0 C. When wet with sea-water the temperature of the thermometer was 23°·5 C., and with rain-water 23°·1 C. Similarly, at noon on the same day, the following temperatures were observed: dry bulb, 26°·1 C.; wet bulb (sea), 24°·5 C.; wet bulb (rain), 24°·2 C. The air, at this time, appeared, to the sensation, to be damper than at any other time, and yet, when suitably exposed, there was a difference of nearly 2° C. between the wet and dry thermometers.

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[1] Having plenty of pounded ice at my disposal, I poured off the water which had formed by melting, and replaced it by sea-water, containing 35·65 grammes salt per kilogramme, and then immersed the thermometer; it fell rapidly below zero, and remained constant at −1°·0. I then strained away the sea water from the ice and replaced it by a mixture of equal volumes sea-water and distilled water: the thermometer fell to −0·45, and remained constant for some time at that temperature. When the ice was mixed with distilled water alone, the thermometer again stood at 0° C. These experiments were made to verify some observations of Pettersson, quoted in his investigations into the nature of ice formed from waters of different degrees of salinity, in connection with the voyage of the *Vega*. He there says, referring to the melting temperature of different kinds of ice, that pure fresh-water ice, when immersed in sea water, melts at a temperature considerably below 0° C. Writing from memory, I think he puts the melting-point at from −1° to −2° C. Having both the ice and the sea-water ready at hand, I repeated this remarkable experiment. The result showed that Pettersson's observation is quite correct, and that the lowering of the melting-point is roughly proportional to the salt held in solution. When equal volumes of the sea-water and distilled water of the same temperature were mixed, there was no change of temperature. I do not remember if Dr. Pettersson furnished an explanation of this remarkable phenomenon, and I am unable to supply one myself, but it must necessarily affect the validity of conclusions as to the composition of sea-water ice drawn from its melting-point. When the *Challenger* was in Antarctic waters I made a number of observations on the melting-point of ice collected from broken pieces of the pack, and found it begin to melt a little below −1° C. I concluded that either it was one solid substance or a mixture of several solids. But if pure ice melts at a different temperature according to the medium in which it is placed, then this reasoning is faulty, for inclosed brine would have much the same effect as inclosed salt or crystalline hydrate.

There is an advantage in having the bulb of the thermometer wet with a continuous film of water, instead of being surrounded with damp muslin, namely, that it more nearly resembles the surface of the sea, which is exposed to the influence of the atmosphere. Observations with the wet thermometer were not made as regularly as those with the dry instrument, and no observations were made with either of them after dark, owing to the difficulty of securing proper exposure and reading the instrument with a lantern, without heating it.

The temperature of the air and of the water were taken generally every two hours from 6 a.m. to 6 p.m., but the intervals between the observations were not always the same. These observations showed that only on two days, January 31 and February 1, between lat. 6° S. and 12° S., did the mean *day* temperature of the air exceed that of the surface-water. On these days the temperatures were taken every two hours from 6 a.m. to 6 p.m., and the means of the groups of seven observations gave, on January 31: air, 27°·13 C.; sea, 26°·90 C.; difference, 0°·23 C.; and on February 1, air, 27°·26 C.; sea, 26°·96 C.; difference, 0°·30 C. These differences would have been reduced in amount if the observations had been carried on through the night, though, from the very high temperature of the air just before sunrise on February 1 and 2, they would not have been reduced to zero.

In the table (p. 129) all the simultaneous observations of temperature of air and water made during the voyage, except those of the last day, when approaching the mouth of the River Plate, are collected in small tables for each day. The time of day is given in hours, from 0 to 24; the temperatures are in Centigrade degrees; $t$ denotes the temperature of the sea-surface, $t - T$ the difference between that of the temperature of the air, and $T - T$ the difference between the readings of the thermometer in air with its bulb dry and when it is wet with sea-water. At the head of each table is given the meteorological district of the ocean through which the ship was passing, as "north-east trade-winds," "equatorial calms," and the like; also the day of the month (1885) and the latitude and longitude at noon of the day. The means at the foot of each table are simply the arithmetical means of the numbers in each column; and their meaning and value are at once apparent on inspecting the column.

With the two exceptions above-named, the temperature of the sea was always found higher than that of the air, over the day, and only very seldom was it exceeded by that of the air at the hottest time of the day. Had the observations been carried on through the night, the contrast between the two temperatures would have been much greater. On January 31 and February 1 the conditions were somewhat exceptional. On the former of these days the ship passed into the northerly monsoon, which prevails all down the Brazilian coast during the southern summer. Like the similar monsoons in the northern hemisphere, it is caused by the proximity of a large mass of land, which gets intensely heated by the vertical rays of the sun. On January 30 the wind had been light south-easterly; during the night it fell calm, and at sunrise a light easterly wind sprang up, which gradually drew around towards the north and blew all day, with just sufficient force to travel exactly at the same rate as the ship (11½ knots); consequently, during the whole of the day the atmosphere on the deck was motionless, with a very powerful sun beating on it and heating up every thing, so that it was impossible to find any place where the air could be got, coming fresh on board, without having been exposed to the influence of the highly-heated deck and fittings. It is therefore certain that the air-temperatures are somewhat above the water.

It is probable that, when the true temperature of the air can be ascertained, it will be found to be usually below that of the sea-surface. The cause of this is, I think, to be found in the relative dryness of the atmosphere over the ocean. If the observations with the wet-bulb thermometer be considered, it will be seen that the least difference of reading between the dry- and the wet-bulb thermometers was 1°·0 C. on January 28, when the ship was in the middle of the equatorial belt of calms and rains. In this region perfectly saturated air might be expected, and with instruments exposed in the usual form of box I have no doubt that here, and in the very oppressive weather of the northerly monsoon, the two instruments would have given identical readings. The readings of the air-temperature on January 28 were perfectly trustworthy, as the sky was thickly overcast with dense rain-clouds all day; there was thus no risk of overheating; the readings with the wetted bulb were equally satisfactory, so that the results of the observations on that day may be taken to represent fairly the normal state of things in the "Doldrums." The temperature of the sea varied from 26°·3 to 26°·6 C., the mean of five observations during the day being 26°·42 C. The mean temperature of the air during the day was 0°·92 lower than that of the sea, or 25°·5 C., and the temperature of the wet-bulb thermometer 1°·3 lower still, or 24°·2 C. It will be seen that, on the two exceptional days, January 31 and February 1, the difference between the wet- and the dry-bulb thermometer is greater than would be expected from the oppressive damp feeling of the air; it is therefore all the more likely that the dry-bulb readings are too high as indicated above. However, it is important to observe that in all the regions passed through, whether in the westerly winds of the North Atlantic or the equatorial calms, or the monsoon of the South Atlantic, the temperature of the wet-bulb thermometer is always very markedly below that of the dry-bulb thermometer. In fact, such is the mobility of the atmosphere that it rarely has the opportunity of saturating itself; and if the effect which must be produced when this air meets the surface of the water be considered, it will, I think, afford some explanation of why at sea the temperature of the air, even by day alone, is usually markedly below that of the sea-surface.

If we consider the film of water immediately at the surface of the sea, having the atmosphere on the one side of it and the bulk of the water on the other, it is strictly comparable with the film of water surrounding the bulb of the thermometer, when exposed to the atmosphere in the way described above; and the air playing upon it must produce exactly the same effect in the one case as in the other. The evaporation lowers the temperature of the aqueous film, which proceeds to extract heat from the neighbouring bodies—namely, in the one case the air and the bulb of the thermometer and in the other case the air and the layer of water immediately below the surface film. If we imagine for a moment the surface film separated from the bulk of the water below it by a diaphragm impervious to heat, then exposed to the atmosphere so as to suffer evaporation and lowering of temperature, then on the removal of the diaphragm it would immediately sink away from the surface and its place would be taken by warmer, and therefore less dense, water from below. In the case of sea-water this effect would be slightly intensified by the concentration produced by evaporation. But

TABLE GIVING THE TEMPERATURE OF THE SEA SURFACE ($t$), THE DIFFERENCE BETWEEN IT AND THE TEMPERATURE OF THE AIR ($t-T$), AND THE DIFFERENCE BETWEEN THE READINGS OF THE DRY BULB AND THE WET BULB THERMOMETERS IN AIR ($T-T'$), AT DIFFERENT HOURS OF THE DAY

N.W. WINDS

Jan. 23, Lat. 26° 24′ N.
Long. 21° 21′ W.

| Hours | $t$ °C | $t-T$ °C | $T-T''$ °C |
|---|---|---|---|
| 8¼ | 18·9 | 2·1 | |
| 10 | 19·3 | 1·1 | |
| 12 | 19·2 | 0·7 | |
| 14 | 19·3 | 0·8 | |
| 16⅓ | 19·7 | 1·7 | |
| 17½ | 19·6 | 1·9 | |
| Mean | 19·33 | 1·38 | |

N.E. TRADE WIND

Jan. 24, Lat. 22° 5′ N.
Long. 23° 6′ W.

| Hours | $t$ °C | $t-T$ °C | $T-T'$ °C |
|---|---|---|---|
| 8¼ | 20·5 | 1·5 | |
| 10½ | 20·7 | 1·0 | |
| 12 | 20·9 | 0·8 | |
| 14 | 21·1 | 1·1 | |
| 16 | 21·2 | 1·2 | |
| 17½ | 21·2 | 1·3 | |
| | 20·93 | 1·15 | |

N.E. TRADE WIND

Jan. 25, Lat. 18° 6′ N.
Long. 24° 39′ W.

| Hours | $t$ °C | $t-T$ °C | $T-T'$ °C |
|---|---|---|---|
| 8¼ | 22·0 | 1·4 | 1·6 |
| 10 | 22·0 | 0·8 | |
| 12 | 22·2 | 0·7 | |
| 14 | 22·2 | 1·0 | |
| 16 | 22·7 | 1·7 | |
| 17¼ | 22·3 | 1·2 | |
| | 22·23 | 1·13 | |

N.E. TRADE WIND

Jan. 26, Lat. 13° 46′ N.
Long. 26° 6′ W.

| Hours | $t$ °C | $t-T$ °C | $T-T'$ °C |
|---|---|---|---|
| 8 | 23·2 | 1·0 | 3·0 |
| 10 | 23·8 | 0·8 | — |
| 12 | 24·0 | 0·7 | 1·8 |
| 14 | 24·0 | 0·9 | 2·1 |
| 16 | 24·2 | 1·1 | |
| 17¼ | 24·2 | 1·0 | |
| | 23·90 | 0·92 | |

N.E. TRADE WIND

Jan. 27, Lat. 9° 25′ N.
Long. 27° 21′ W.

| Hours | $t$ °C | $t-T$ °C | $T-T'$ °C |
|---|---|---|---|
| 6 | 25·4 | 1·5 | |
| 8 | 25·6 | 0·9 | 2·7 |
| 10 | 25·7 | 0·9 | |
| 13 | 26·0 | 1·0 | 3·0 |
| 16 | 26·0 | 1·0 | |
| 17½ | 26·0 | 1·0 | |
| | 25·79 | 1·05 | |

EQUATORIAL CALMS

Jan. 28, Lat. 5° 16′ N.
Long. 28° 32′ W.

| | | | |
|---|---|---|---|
| 6 | 26·4 | 6·7 | 1·7 |
| 9 | 26·3 | 1·0 | — |
| 12 | 26·3 | 1·1 | 1·4 |
| 15 | 26·6 | 1·0 | 1·1 |
| 18 | 26·5 | 0·8 | 1·0 |
| Mean | 26·42 | 0·92 | 1·30 |

EQUATORIAL CALMS

Jan. 29, Lat. 1° 15′ N.
Long. 29° 16′ W.

| | | | |
|---|---|---|---|
| 6 | 26·5 | 0·6 | 1·4 |
| 9 | 26·7 | 0·8 | — |
| 12 | 27·0 | 0·3 | 1·8 |
| 15 | 27·0 | 0·0 | 2·5 |
| 18 | 26·8 | 0·2 | 2·3 |
| | 26·80 | 0·38 | 2·00 |

S.E. TRADE WIND

Jan. 30, Lat. 2° 53′ S.
Long. 31° 5′ W.

| | | | |
|---|---|---|---|
| 6 | 26·3 | 0·3 | 1·6 |
| 9 | 26·4 | −0·2 | 1·9 |
| 12 | 26·8 | 0·0 | 2·4 |
| 15 | 27·0 | +0·4 | 2·2 |
| 18 | 26·8 | 0·7 | 1·8 |
| | 26·67 | 0·24 | 1·98 |

NORTHERLY MONSOON

Jan. 31, Lat. 7° 5′ S.
Long. 33° 2′ W.

| | | | |
|---|---|---|---|
| 6 | 26·5 | 0·5 | 1·7 |
| 8 | 26·5 | −0·2 | 2·3 |
| 10 | 26·8 | −0·6 | 2·6 |
| 12 | 27·1 | −0·7 | 2·8 |
| 14 | 27·4 | −0·3 | 2·6 |
| 16 | 27·1 | −0·3 | — |
| 18 | 26·9 | 0·0 | 2·3 |
| | 26·90 | −0·23 | 2·38 |

NORTHERLY MONSOON

Feb. 1, Lat. 11° 18′ S.
Long. 34° 53′ W.

| | | | |
|---|---|---|---|
| 6 | 26·8 | 0·1 | 2·4 |
| 8 | 26·9 | −0·1 | 2·2 |
| 10 | 27·0 | −0·3 | 2·7 |
| 12 | 27·0 | −0·8 | — |
| 14 | 27·0 | −0·7 | 2·8 |
| 16 | 27·0 | −0·3 | 2·3 |
| 18 | 27·0 | 0·0 | 2·0 |
| | 26·96 | −0·30 | 2·40 |

NORTHERLY MONSOON

Feb. 2, Lat. 15° 30′ S.
Long. 36° 53′ W.

| | | | |
|---|---|---|---|
| 6 | 26·9 | −0·1 | 2·3 |
| 8 | 26·9 | −0·1 | 2·0 |
| 10½ | 26·7 | +1·7 | 1·5 |
| 12 | 26·9 | 0·8 | 1·6 |
| 16¼ | 26·3 | 0·3 | |
| 18 | 25·5 | −0·2 | |
| Mean | 26·54 | 0·40 | 1·85 |

NORTHERLY MONSOON

Feb. 3, Lat. 19° 48′ S.
Long. 38° 42′ W.

| | | | |
|---|---|---|---|
| 6 | 24·3 | 0·1 | 1·8 |
| 8 | 25·7 | 0·8 | 2·1 |
| 9 | 25·4 | 0·6 | — |
| 12 | 25·2 | 1·2 | — |
| 14 | 25·9 | 1·3 | 1·8 |
| 16 | 26·0 | 0·1 | 1·6 |
| 18 | 25·9 | 0·0 | — |
| | 25·48 | 0·60 | 1·82 |

S.E. TRADE WIND

Feb. 4, Lat. 24° 0′ S.
Long. 40° 33′ W.

| | | | |
|---|---|---|---|
| 5½ | 25·5 | 1·5 | — |
| 8 | 26·0 | 1·1 | 2·9 |
| 10 | 25·8 | 0·2 | — |
| 12 | 25·7 | 0·5 | 2·9 |
| 14 | 25·8 | 0·8 | 2·8 |
| 16 | 26·0 | 1·0 | — |
| | 25·80 | 0·85 | 2·87 |

S.E. TRADE WIND

Feb. 5, Lat. 27° 8′ S.
Long. 44° 1′ W.

| | | | |
|---|---|---|---|
| 5½ | 24·4 | 0·6 | — |
| 8 | 24·5 | 0·2 | 2·8 |
| 10 | 24·5 | −0·3 | 3·7 |
| 12 | 25·2 | −0·1 | 3·3 |
| 14 | 26·4 | +1·4 | 4·7 |
| 16¼ | 26·7 | 2·0 | 3·5 |
| 18 | 26·3 | 2·0 | 4·3 |
| | 25·43 | 0·97 | 3·72 |

S.E. TRADE WIND

Feb. 6, Lat. 30° 13′ S.
Long. 47° 52′ W.

| | | | |
|---|---|---|---|
| 6 | 24·7 | 0·6 | 2·8 |
| 8 | 25·0 | 0·7 | 2·7 |
| 10 | 24·8 | 1·1 | 2·7 |
| 14 | 25·2 | 0·9 | 3·0 |
| 16 | 24·7 | 0·7 | 2·9 |
| 18 | 24·8 | 1·1 | 3·7 |
| | 24·87 | 0·85 | 2·97 |

while the water below supplies some of the heat rendered latent by the evaporation of the water, the air above it supplies its share, and is cooled. In both cases the heat thus lost is made good by the direct radiation from the sun. Through a moderately dry atmosphere the rays pass with comparatively little heating effect, but are largely absorbed on entering the water. Consequently the loss of heat which the water suffers by evaporation at the surface of separation is made good more abundantly than that sustained by the air; and the difference in power of absorption of radiant heat exhibited by these two substances is thus sufficient to keep up a permanent difference of temperature between the water and the air immediately above it.

Starting with air and water at the same temperature, we may imagine the process taking place in three acts. First, the water at the surface evaporates, and the air on the one side, and the water on the other, are cooled; second, in order to make up for the heat thus rendered latent and lost, the sun shines upon both alike, but the water absorbs a larger proportion of the heat of its rays than the air does; and finally, a portion of this excess is then removed from the water by the simple contact of the air at its surface. The nett effect of these causes is to produce a permanent excess of temperature of the surface-water of the sea over that of the air above it, provided that that air is not completely saturated with moisture.

From what I have seen and experienced in the regions visited by the south-west monsoon in the east, I cannot doubt that there are often cases where the most carefully exposed wet- and dry-bulb thermometers would show identical readings, and the atmosphere is completely saturated with vapour of water. Thus it is probable that the temperature of the air would not be inferior to that of the water. Further, when, on the eastern coasts of Asia, the south-west monsoon blows out of the China Sea and penetrates far into the North Pacific, off the coasts of Japan it attains a latitude of naturally lower temperature than that from which it proceeded, so that much of the water with which it was laden, and which is held diffused through it as a mere gas, is condensed and remains suspended in it, producing a visible haze, which obscures the horizon and condenses on all solid objects exposed to it. Here the conditions are reversed, and instead of the air losing heat to evaporate the water, it receives the heat liberated by the condensation of the steam removed from waters of lower latitudes. Such conditions are, however, certainly exceptional, and there can be little doubt that, as a rule, the temperature of the surface-water of the sea is higher than that of the air. The temperature of the air depends on that of the water which tends to warm it and the degree of its own dryness, by virtue of which the water has a tendency to evaporate into it and, by extracting heat from it for this purpose, to cool it.

It is obvious that local circumstances such as currents may produce differences between the temperature of the air and the water, but such cases are not here under consideration.

J. Y. BUCHANAN

Mendoza, March 18

## THE REV. T. W. WEBB

BY the death of the Rev. Thomas William Webb, M.A., F.R.A.S., English astronomy has lost one of its most assiduous and accomplished votaries. Mr. Webb, who had reached the age of 79 years, passed a long life as the incumbent of two obscure Welsh livings, held by him in succession. At Tretire he may be said to have laid the foundations of those astronomical tastes which took their finished and best-known shape during the later years of his life whilst he was incumbent of Hardwick, in Breconshire. He was a genial and right-thinking parish priest, whose highest aim was the performance of his duty. For the sake of astronomy it was well perhaps that he obtained so little ecclesiastical advancement; for had things been otherwise it is probable that he would never have developed those scientific tastes which have made his name almost a household word. It was my privilege to make his acquaintance upwards of twenty years ago, and I look back with extreme pleasure to the many letters which have passed between us on practical matters connected with observational astronomy and the use of instruments. Whilst Mr. Webb in bygone years used to write a good deal in the current scientific magazines of the day, especially the *Intellectual Observer* and the *Student*, it was by his "Celestial Objects for Common Telescopes" that he became chiefly known in the astronomical world. This work, published in the year 1859, was designed to be a cheap popular abridgment in a modified form of Admiral Smyth's "Celestial Cycle," which had done right good service in providing English amateurs with information as to what to look for and how to find. By 1859 Smyth's work had become both out of print and somewhat out of date, and Mr. Webb's unpretending abridgment filled at once an undoubted void. It is indeed not wholly correct to speak of Webb's "Celestial Objects" as an abridgment of Smyth's older, larger, and more expensive volume. It was this; but it was also a good deal more, for whilst it offered to the possessors of small telescopes convenient lists of objects deserving of their attention, it also supplied an enormous amount of original information connected with the sun, moon, and planets, and the use of telescopes. This information, though no doubt suggested by Admiral Smyth's style, was no mere *rechauffé* of other people's work, but represented the personal experience of an intensely industrious and persevering man working under great difficulties through lack of instrumental means.

I shall never forget the feeling of blank astonishment which crept over my mind one day when (in, I think, the year 1864) Mr. Webb told me that the first edition of his book, and all his magazine articles up to that date describing double stars and clusters, were founded on studies pursued by means of a telescope set up in his garden and not equatorially mounted. This, I well remember, was not said in any spirit of boasting in the garb of mock modesty, but was the casual utterance of a simple truth disclosed without effort or intention. I do not think I ever came in the way of any student of nature of whom it could be so truly said that he was "without guile."

Mr. Webb was every inch a gentleman, and a philosopher in the highest sense of the word. Every line that he wrote contained either the record of some fact noticed by himself, or a sensible deduction from some other facts. When his facts had come to an end his pen ceased to pass over paper, and the result was that no one ever read a sentence written by him without learning something useful, set forth in the fewest possible words, often, indeed, in a form of concentration which erred on the side of inconvenient brevity; but in these days of penny-a-lining (and it may even be admitted that there is even such a thing as science penny-a-lining) Mr. Webb's habitual terseness cannot be described as a vice. His private letters show that, where necessary for the instruction of a young astronomer, he never grudged time and trouble for going into details. The highest praise that can be awarded him is that he not only did many useful things himself, but that he set an example of patient and industrious research which resulted in many young men all over the British Empire seeking to imitate his cheery and sensible style of work and thought.

G. F. CHAMBERS